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The Longitudinal Relationship between Depression Symptoms and Disability for Older Adults: A population-based study

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Abstract

Background. Although depressive symptoms in older adults are common, their relationship with disability and the influence of disability on the development of depressive symptoms over time is not well understood. This longitudinal study investigates the change trajectories of both depressive symptoms and disability, as well as their associations over time. Methods. Participants included 442 community-dwelling older adults living in Taiwan, aged 65 years or older, who completed six waves of survey interviews. Depression was scored with the Short Psychiatric Evaluation Schedule and disability with the instrumental and physical activities of daily living measure during each consecutive data collection wave. The autoregressive latent trajectory model and parallel latent growth curve modeling were adopted for analysis of the data. Results. The autoregressive latent trajectory model highlights that previous depressive symptoms (and disability) significantly contributed to the advancement of more severe depressive symptoms (and disability). This model also indicates that disability significantly contributed to the onset of depressive symptoms and vice versa. The parallel latent growth curve modeling highlights that the disability intercept had significant effects on the depressive symptoms intercept, as did the depressive symptoms on disability. Furthermore, the disability slope had significant effects on the slope of the depressive symptoms. Conclusions. These findings demonstrate that disability is a stronger predictor of depressive symptoms than depressive symptoms are of disability. In addition, the prior existence of a health condition will lead to further deterioration of health conditions and that they often coexist.

Keywords

study, longitudinal, population, relationship, between, adults, depression, older, disability, symptoms

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The Longitudinal Relationship Between Depressive Symptoms and Disability for Older Adults: A Population-Based Study

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Background. Although depressive symptoms in older adults are common, their relationship with disability and the influence of disability on the development of depressive symptoms over time is not well understood. This longitudinal study investigates the change trajectories of both depressive symptoms and disability, as well as their associations over time.

Methods. Participants included 442 community-dwelling older adults living in Taiwan, aged 65 years or older, who completed six waves of survey interviews. Depression was scored with the Short Psychiatric Evaluation Schedule and disability with the instrumental and physical activities of daily living measure during each consecutive data collection wave. The autoregressive latent trajectory model and parallel latent growth curve modeling were adopted for analysis of the data.

Results. The autoregressive latent trajectory model highlights that previous depressive symptoms (and disability) significantly contributed to the advancement of more severe depressive symptoms (and disability). This model also indicates that disability significantly contributed to the onset of depressive symptoms and vice versa. The parallel latent growth curve modeling highlights that the disability intercept had significant effects on the depressive symptoms intercept, as did the depressive symptoms on disability. Furthermore, the disability slope had significant effects on the slope of the depressive symptoms.

Conclusions. These findings demonstrate that disability is a stronger predictor of depressive symptoms than depressive symptoms are of disability. In addition, the prior existence of a health condition will lead to further deterioration of health conditions and that they often coexist.

Key Words: Depressive symptoms—Disability—Older population.

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DEPRESSION is one of the most common mental health disorders experienced by older adults, with its prevalence increasing with age (1). In Taiwan, it is estimated that the prevalence of depression among older adults is much higher (2,3) than that in industrialized countries (4,5). Depression in this older adult population is, therefore, a significant public health issue because it is often associated with an increase in a poor quality of life (6), suicidal tendencies (7), and an increase in the risk of death (8).

Depression is projected to be the leading cause of disability in high-income nations, including the United States, and the second leading cause of disability worldwide (9). Empirical evidence generally supports the hypothesis that disability may increase the risk of depression (2,10) and also the worse the depressive symptoms the more serious the disability (11–14), therefore negatively impacting upon the person's psychological well-being and their ability to physically function normally (15). It is also worth noting that both depressive symptoms and disability are dynamic and progressive processes, linked with the consequences of underlying comorbid chronic conditions often associated with aging (16–18).

To date, cross-sectional studies have examined the association between depression and its related factors, such as disability (19,20). Whereas, longitudinal studies investigating depressive symptoms and disability have not addressed how related factors, including disability, have influenced the development of depressive symptoms over time (21). Furthermore, other longitudinal studies focusing on depression, used repetitive measurements over time (13,22), but did not examine the baseline measurements and longitudinal changes for each individual. Based on the lack of evidence about links between changes in depression and disability,

especially from a longitudinal perspective in an Asian setting (23), the present study targeted Chinese elderly people residing in Taiwan.

This article aims to explore the longitudinal causal association between depressive symptoms and disability among community dwelling older Taiwanese adults, who completed six biennial interview survey waves between 1994 and 2004. Our initial assumption was that the autoregressive latent trajectory (ALT) model would be a better model fit to examine the longitudinal association between depressive symptoms and disability, as compared with latent growth curve modeling (LGCM). To predict the association between depressive symptoms and disability, we first hypothesized that an increasing trajectory of depressive symptoms and disability occurred in the Chinese elderly population with a stronger direct effect for depressive symptoms on disability, as compared with disability on depressive symptoms. We also hypothesized that the existence of a previous depressive symptoms and disability contributed to the onset and/or the advancement of more severe depressive symptoms and disability. We further hypothesized that the development of depressive symptoms affected by disability was stronger than the development of disability affected by depressive symptoms.

Methods

Study Population and Sample

The present study adopted a prospective study design using closed cohort baseline data from an older adult Taiwanese population obtained from the Kaohsiung City government. In 1994, about 86,000 older adults (aged 65 years and older) lived in Kaohsiung City, which is the second largest metropolitan area in southern Taiwan, with a population of 1.3 million (24). Among the 11 urban administration districts in Kaohsiung City, the San-Min District was selected for the study because the proportion of older adults in this population was very similar to that in Kaohsiung City as a whole. The study sample consisted of a two-stage random sampling method. The first stage was a random selection of 21 basic administrative units within the San-Min District, and the second stage was a systematic one-in-two or 50% of the older adult population within these units. This cohort selection has been described in detail elsewhere (2), and only those participants who successfully completed all five biennial follow-up survey waves were included in the analyses for this study.

Data Collection

Baseline survey interviews were administered in 1994, with five follow-up biennial surveys conducted in the next ensuing 10 years. Of these, 1,260 participants were interviewed at baseline (88% response rate), 1,003 participants (in 1996), 874 participants (in 1998), 700 participants (in 2000), and 589 participants (in 2002) during the intermediate survey waves. Then finally, in 2004, 458 participants (60% response rate after taking into account those that had died and those that were lost to follow-up) successfully completed the final interview survey wave. In total, of the 1,260 participants at baseline, 490 died during the study period and 312 were lost to follow up. In addition, for the purpose of these analyses, 16 of the 458 participants who completed the final survey in 2004 had missed one or more of the intermediate survey waves and were therefore excluded from the final analyses, resulting in a total of 442 older adult participants.

Research Instrument

The survey instrument used in this study was the Chinese version of the Multidimensional Functional Assessment Questionnaire (CMFAQ), which is based on the Older American Assessment Resource and Service Center (OARS) assessment instrument developed by Duke University (25). Because the reliability and validity of the CMFAQ were investigated and found satisfactory (26), they were used in the initial and five follow-up biennial survey waves of this study, conducted by senior students and/or graduate students from Kaohsiung Medical University.

Measurement of Depressive Symptoms

Depression was evaluated using the Short Psychiatric Evaluation Schedule (27). The Short Psychiatric Evaluation Schedule is a 15-item questionnaire to which participants responded by indicating "yes" or "no" to questions about depressive symptoms (eg, not waking fresh and rested; daily life not interesting; wanted to leave home). The 15 binary variables ("yes" = 1, "no" = 0) were then summed together, creating a single score to assess depressive symptoms, ranging from 0 (best) to 15 (worst). Based on the evidence, a cutoff Short Psychiatric Evaluation Schedule score of ≥ 4 was used to determine the presence of depressive symptoms in the participants (27), with higher scores indicating higher levels of depressive symptoms.

Measurement of Disability

Disability was assessed using the Instrumental Activities of Daily Living (IADL [28]) and Physical Activities of Daily Living (PADL [29]) scales. The measurements taken were used to ascertain the degree of difficulty, the older adults had in going about their daily routines. The status of each of the seven IADL disabilities (phoning, using public transport, shopping, cooking, doing housework, taking medication, and handling finances) and the seven PADL disabilities (eating, dressing, grooming, walking, transferring, bathing, and toileting) were measured for each of the participants during the consecutive survey waves. IADL

Table 1. Baseline Characteristic of Study Population in 1994 ($N = 442$)

	Depressive Symptoms			Disability		
	No	Yes		No	Yes	
	$n = 360$ (%)	$n = 82$ (%)	p	$n = 367$ (%)	$n = 75$ (%)	p
Age (y)						
65–69	203 (56.4)	48 (58.5)	.905	223 (60.8)	28 (37.3)	***
70–74	119 (33.1)	25 (30.5)		113 (30.8)	31 (41.3)	
75 and older	38 (10.6)	9 (11.0)		31 (8.4)	16 (21.3)	
Gender						
Female	174 (48.3)	55 (67.1)	**	179 (48.8)	50 (66.7)	**
Male	186 (51.7)	27 (32.9)		188 (51.2)	25 (33.3)	
Education						
Illiterate	95 (26.4)	38 (46.3)	***	94 (25.6)	39 (52.0)	***
6 years or less	143 (39.7)	33 (40.2)		149 (40.6)	27 (36.0)	
7 years or more	122 (33.9)	11 (13.4)		124 (33.8)	9 (12.0)	
Regular exercise						
No	134 (37.2)	44 (53.7)	**	137 (37.3)	41 (54.7)	**
Yes	223 (61.9)	37 (45.1)		226 (61.6)	34 (45.3)	
Marital status						
Married	293 (81.4)	62 (75.6)	.235	300 (81.7)	55 (73.3)	.095
Single/divorced/widowed	67 (18.6)	20 (24.4)		67 (18.3)	20 (26.7)	
Living Arrangement						
Alone	4 (1.1)	2 (2.4)	.620	6 (1.6)	0 (0.0)	.529
Live with spouse/kids	345 (95.8)	78 (95.1)		350 (95.4)	73 (97.3)	
With others	11 (3.1)	2 (2.4)		11 (3.0)	2 (2.7)	
Chronic disease						
No disease	104 (28.9)	10 (12.2)	**	96 (26.2)	18 (24.0)	.697
Any disease	256 (71.1)	72 (87.8)		271 (73.8)	57 (76.0)	
Disability status						
No disability	307 (85.3)	60 (73.2)	**			
Disability	53 (14.7)	22 (26.8)				
Depression status						
No depression				307 (83.7)	53 (70.7)	**
Depression				60 (16.3)	22 (29.3)	

*$p < .05$, **$p < .01$, and ***$p < .001$.

and PADL disability scores ranged from 0 to 2, where 0 points were awarded for the answer "no difficulty," and two points were awarded for the answer "completely impossible." For the purposes of this study, the IADL and PADL scores were combined as a "disability" variable, suggesting that the higher the score the more serious the disability. The disability domain was defined as "yes" for difficulty in performing one or more activities. Conversely, the disability domain was defined "no" when there was no difficulty in performing activities.

Other Measures (Covariates)

Other control variables included in the analyses of this study were the participants' demographic characteristics, such as marital status, educational level achieved (classified as illiterate, equal or less than 6 years of education—primary education, and those who completed 7 or more years of education), lifestyle behaviors (ie, regular exercise), and the number of chronic diseases assessed during the initial baseline interview survey. The demographic variables included age (classified as 65–69 years, 70–74 years, and 75 years and older), gender, and living arrangements. Regular exercise, marital status, and living arrangements were dichotomized according to whether the participants took part in regular exercise or not, were or were not married, and whether or not they lived alone. The number of chronic diseases was treated as a control variable, and responses were sought to whether a physician had ever told them that they had 1 of the 27 listed chronic diseases on the survey tool.

Analytical Design and Approach

A descriptive analysis provided an overview of the study sample at baseline. A comparison of depressive symptoms and disability scores for the different survey waves were conducted by using repeated analysis of variance measures. In order to construct better prediction models, LGCM was initially performed, as per the evidence (21). An ALT modeling approach, as proposed by Bollen and Curran (30) as well as Wan (31), was also adopted to investigate individual trajectories and the effect of earlier depressive symptoms and disability. This was deemed appropriate, as the ALT approach expands on the LGCM approach by including autoregressive endogenous variables (eg, the repeated depressive symptoms and disability measures as well as covariates) allowing examination of the consequence of depressive symptoms and disability during each

Table 2. Mean Values for Depressive Symptoms and Disability at Each of the Six Waves ($N = 442$)

Health Status	Year	Mean (*SD*)	95% CI
Depressive symptoms	1994	2.03 (2.34)	1.81–2.25
	1996	1.68 (2.10)	1.49–1.88
	1998	2.04 (2.49)	1.81–2.27
	2000	2.96 (2.62)	2.71–3.20
	2002	3.52 (2.94)	3.24–3.79
	2004	3.28 (3.40)	2.96–3.60
Disability	1994	0.33 (0.95)	0.24–0.42
	1996	0.68 (2.20)	0.47–0.88
	1998	1.00 (2.83)	0.74–1.27
	2000	1.44 (3.41)	1.12–1.76
	2002	2.29 (4.23)	1.89–2.68
	2004	3.36 (5.95)	2.80–3.91

of the interview survey waves. Interrelationships between depressive symptoms and disability were further explored by using parallel LGCM to identify the development of depressive symptoms and disability. The goodness of fit was determined by the chi-square value, the comparative fit index (CFI), the Tucker–Lewis index (TLI), and the root mean square error of approximation (RMSEA). Furthermore, maximum likelihood model based on AMOS was used to obtain estimated parameter values, and data were analyzed using SPSS17.0 (Chicago, IL) and AMOS 8.0 (Chicago, IL).

Results

Table 1 presents the distribution of baseline information based on depressive symptoms and disability. As compared with male counterparts, female older adults experienced a significantly higher percentage of depressive symptoms (67.1%) and disabilities (66.7%). Illiterate older adults demonstrated a higher percentage of depressive symptoms (46.3%) and disabilities (52.0%). Although those who did not take part in regular exercise, experienced a higher percentage of both conditions (53.7% and 54.7%), as compared with those who took part in regular exercise. About one quarter (24.4% vs 26.7%) of the participants were single, divorced, or widowed with the majority of them living with family members (95.1% vs 97.3%). The presence of chronic disease was significantly associated with depressive symptoms (87.8%) and disability (76.0%).

Table 2 presents the means, *SD*, and 95% confidence interval for both depressive symptoms and disability scores throughout the 10-year data collection period. For both health conditions, a higher mean score represents poorer health status among the participants who completed all six interview survey waves. The results suggest that there was a statistically significant increase in the mean scores for disability (from 0.33 in 1994 to 3.36 in 2004). Whereas even though, there were overall increasing trends in depressive symptoms during that time, fluctuations occurred at baseline and the final data collection year (2004). Notably, the distributions for both depressive symptoms and disability scores had large standard deviations, reflecting substantial variability for both health conditions, which was especially the case for disability scores.

Latent Growth Curve Models

To investigate a potential relationship between depressive symptoms and disability, LGCM was initially used to evaluate the association between the older adults' initial health status and their changing trajectories over time, without time-variant and time-constant control variables (see Figure 1A). The residual terms were assumed to be correlated because it was possible that potential predictor variables, such as the participants' demographic characteristics, had not been included in the prediction. The LGCM results indicate that the goodness of fit statistics for both of these models (depressive symptoms and disability) were poor (ie, chi-square values are 5.716 and 7.896, respectively, CFI of 0.915 and 0.953, TLI of 0.884 and 0.910, and RMSEA of 0.103 and 0.125, respectively (not shown in the table).

ALT Model

Based on the poor model of fit for the LGCM, the ALT model was used to perform the analyses because time-constant and time-varying covariates were included as control variables for the endogenous variables. The ALT model included time-constant predictor variables as having direct causal paths with the baseline wave of data collection, which postulated that the variables measured in 1994 directly influenced the change trajectories for depressive symptoms and disability scores over the next five ensuing waves of data collection. This model therefore enabled the concomitant effects of the time-varying variables, such as the effect of disability on depressive symptoms in each wave to be tested.

For the depressive symptoms model, this study examined whether or not disability as a time-varying variable contributes to the onset of depressive symptoms, when these contextual variables are simultaneously considered (Figure 1B). Figure 1B highlights that during the last four data collection periods (1996, 1998, 2000, and 2002), previous depressive symptoms significantly contributed to the advancement of more severe depressive symptoms. Furthermore, the figure also indicates that disability significantly contributed to the onset of depressive symptoms in 1994, 1996, 2000, and 2004. This ALT model demonstrated an excellent fit to the data (chi-square value = 2.585, CFI = 0.936, TLI = 0.899, and RMSEA = 0.060; Table 3).

For the disability model, this study examined whether or not the effects of the time-variant variable depressive symptoms contributes to the onset of disability during consecutive waves while controlling for prior disability and covariates. For the disability model, Figure 1B highlights that during the last five data collection periods (1.015 in

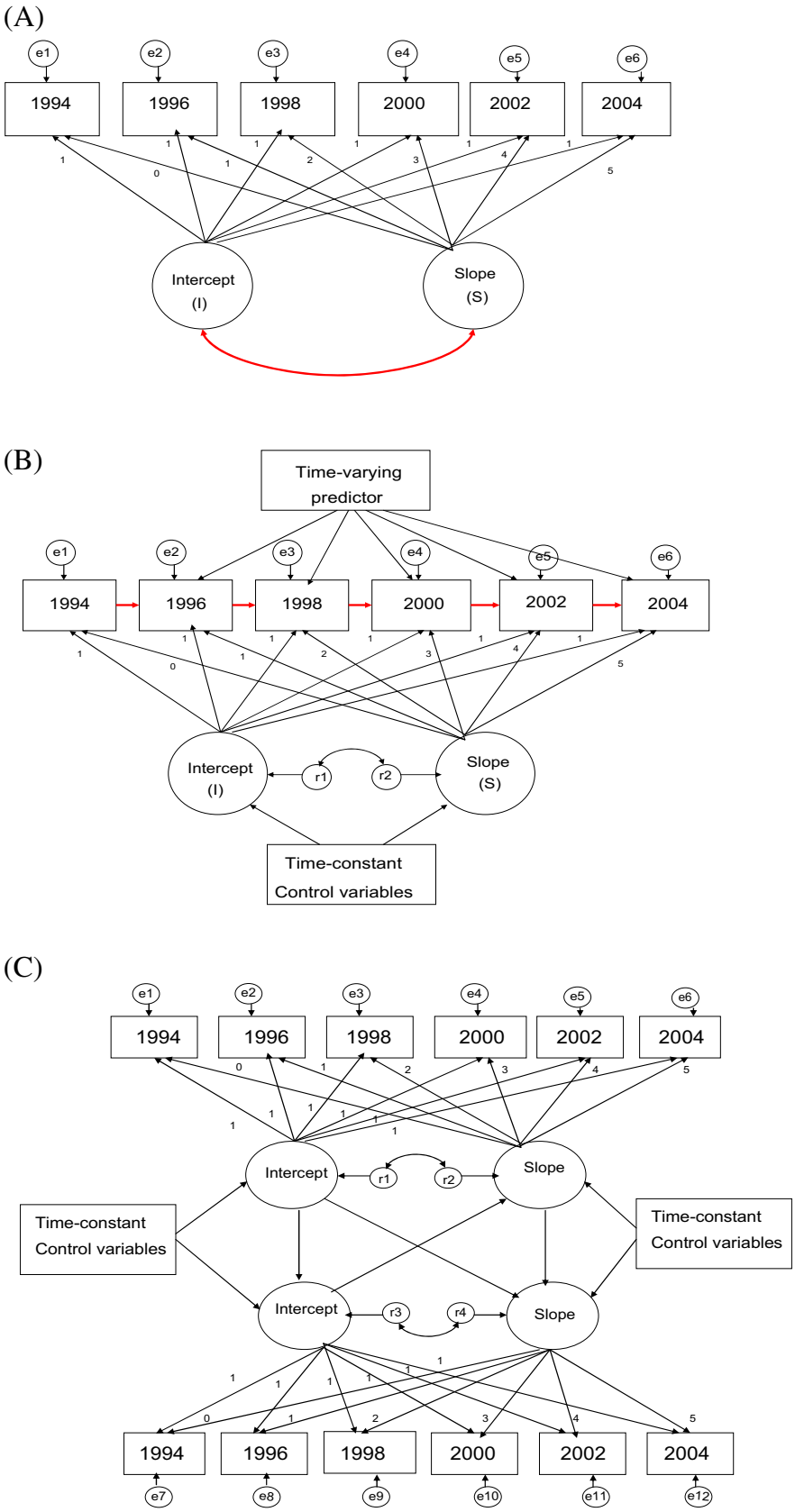

Figure 1. (**A**) Latent growth curve trajectory model for depressive symptoms and disability. (**B**) Autoregressive latent trajectory model for depressive symptoms and disability with time-constant and time-varying predictors. (**C**) Parallel latent trajectory model for depressive symptoms and disability with time-constant predictors.

Table 3. An Autoregressive Latent Trajectory Model for Depression and Disability Change, 1994–2004

		β	*SE*	C.R.	*p* Value
Time-variant predictors for depressive symptoms					
Depr94 on. . .	R^2 = .381				
Disa94		0.652	0.1	6.538	***
Depr96 on. . .	R^2 = .344				
Depr94		−0.036	0.045	−0.797	.425
Disa96		0.125	0.043	2.915	.004
Depr98 on. . .	R^2 = .346				
Depr96		0.208	0.051	4.113	***
Disa98		0.071	0.037	1.928	.054
Depr00 on. . .	R^2 = .346				
Depr98		0.225	0.051	4.422	***
Disa00		0.211	0.032	6.602	***
Depr02 on. . .	R^2 = .366				
Depr00		0.398	0.06	6.605	***
Disa02		0.098	0.028	3.485	***
Depr04 on. . .	R^2 = .221				
Depr02		0.337	0.073	4.639	***
Disa04		0.043	0.024	1.787	.074
Chi-square value = 2.585, CFI = 0.936, TLI = 0.899, and RMSEA = 0.060					
Time-variant predictors for disability					
Disa94 on. . .	R^2 = .347				
Depr94		0.110	0.017	6.610	***
Disa96 on. . .	R^2 = .516				
Disa94		1.015	0.127	8.009	***
Depr96		0.040	0.031	1.286	.198
Disa98 on. . .	R^2 = .795				
Disa96		0.703	0.048	14.751	***
Depr98		0.037	0.025	1.499	.134
Disa00 on. . .	R^2 = .509				
Disa98		0.272	0.057	4.730	***
Depr00		0.210	0.035	5.931	***
Disa02 on. . .	R^2 = .587				
Disa00		0.341	0.056	6.044	***
Depr02		0.240	0.037	6.479	***
Disa04 on. . .	R^2 = .606				
Disa02		0.557	0.062	9.029	***
Depr04		0.269	0.049	5.521	***
Chi-square value = 3.356, CFI = 0.904, TLI = 0.850, and RMSEA = 0.073					

Notes: Adjusted for age, gender, education, doing exercise, marital status, living arrangement, and chronic disease. CFI = comparative fit index; C.R.= critical ratio for regression weight; RMSEA = root mean square error of approximation; and TLI = Tucker–Lewis index.

*** $p < .001$.

1994, 0.703 in 1996, 0.272 in 1998, 0.341 in 2000, and 0.557 in 2002), previous disability significantly contributed to the advancement of more severe disability. Furthermore, the figure also indicates that depressive symptoms significantly contributed to the onset of disability in 2000 (β = 0.210), 2002 (β = 0.240), and 2004 (β = 0.269). The ALT

Table 4. Parallel Growth Curve Model for Depression and Disability

	β	*SE*	C.R.	*p* Value
Depressive symptoms				
Depr Intercept ← Disa Intercept	0.451	0.136	3.303	***
Disa slope ← Depr Intercept	0.008	0.022	0.387	0.699
Depr slope ← Disa slope	0.435	0.194	2.246	*
Depr slope ← Disa Intercept	0.017	0.066	0.255	0.799
Model fit: chi square = 2.166; CFI = 0.955; TLI = 0.926; RMSEA = 0.051				
Disability				
Disa Intercept ← Depr Intercept	0.215	0.056	3.813	***
Depr slope ← Disa Intercept	−0.061	0.032	−1.888	0.059
Disa slope ← Depr Intercept	−0.178	0.168	−1.06	0.289
Disa slope ← Depr slope	−1.35	1.511	−0.893	0.372
Model fit: chi square = 2.185; CFI = 0.954; TLI = 0.925; RMSEA = 0.052				

Notes: Adjusted for age, gender, education, doing exercise, marital status, living arrangement, and chronic disease. CFI = comparative fit index; C.R.= critical ratio for regression weight; RMSEA = root mean square error of approximation; and TLI = Tucker–Lewis index.

* $p < .05$ and *** $p < .001$.

model with predictor variables, therefore, provides an acceptable fit to the data (chi-square value = 3.356, CFI = 0.904, TLI = 0.850, and RMSEA = 0.073; Table 3).

Parallel LGC Model

Parallel LGCM analyses were conducted to examine whether disability was related to depressive symptoms and vice versa, and whether there was a change in trajectory over time (Figure 1C). Table 4 shows the results of the parallel LGCM model, the relationships between change trajectories of depressive symptoms and disability. For this model representative of the relationship between prior disability contributing to depressive symptoms, there was a much better goodness of fit for the data (chi-square value = 2.166, CFI = 0.955, TLI = 0.926, and RMSEA=0.051), as compared with LGCM (Figure 1A). Figure 1C also highlights that the disability intercept significantly effects the depressive symptoms intercept ($\beta = 0.451$). In this model, the disability slope also had significant effects on the depressive symptoms slope ($\beta = 0.435$). In contrast, for the model representative of the relationship between prior depression contributing to disability, a goodness of fit for the data was also noted (chi-square value = 2.185, CFI = 0.954, TLI = 0.925, and RMSEA = 0.052). In this latter model, however, only the depression intercept had significant effects on the disability intercept ($\beta = 0.215$).

Discussion

In this longitudinal study, which included six assessments of depressive symptoms and disability of the same older adult participants over a decade, prior mental health and physical functional disabilities consistently affected one another during subsequent years. This study found that disability was much more likely to affect the increase in the depressive symptom trajectory over time, as compared with the influence of depressive symptoms on the increase of the disability trajectory over time. Furthermore, this study also found a strong association between the initial onset of disability with the initial onset of depressive symptoms and vice versa as well as between the development of both disability and depressive symptoms. These study findings suggest a causal association between these two serious health conditions (ie, depressive symptoms and disability) in the older adult population, which have not been found in previous longitudinal research using statistical approaches.

This study investigated the causal association viewing the data from two different perspectives (ie, from depression to disability as well as from disability to depression) while controlling for demographic variables, marital status, educational levels achieved, lifestyle behaviors, and the number of chronic diseases diagnosed by a physician. For disability, there was a general upward trend with prior disabilities consistently predicting disabilities in later years of life. Whereas, even though prior depressive symptoms demonstrated similar upward trends in depressive symptoms in later years of life, fluctuations seemed to occur during some of the intermittent years. Specifically, lag effects were found to occur for both of these health conditions, with significant associations between prior depressive symptoms and changes in depressive symptoms as well as prior disability and changes in disability over time. For example, prior disability in 1994 led to an increase in disability in 1996, thus predicting the development of disability over time. These findings are consistent with some of the findings of Kelley-Moore and Ferraro (32) who also investigated disability and depression and found similar direct lagged effects in their longitudinal study of 3,642 participants. The findings of this study, however, go beyond the findings of Kelley-Moore and Ferraro (32) because their study failed to consider the change trajectories of depressive symptoms and disability over time.

This study found that the development or trajectory of depressive symptoms during the 10-year data collection period was strongly influenced by disability, which is a similar finding to previous studies of much shorter duration (33,34). This study also confirmed the importance of the effects of disability on the development of depressive symptoms in older adults, which often times resulted in these effects being experienced in the same survey year. These findings are in agreement with Ormel and colleagues (35) who found that disability had a stronger direct effect on depression rather than vice versa, even though the study of Ormel and colleagues only focused on three waves of data collection. It should be noted that as compared with depression to disability trajectory, the disability to depression trajectory resulted in a better model of fit, even though both trajectories meet the statistics criteria. Overall, therefore, our study provided new evidence about the longitudinal causal relationship between the two health conditions.

In the model construction process, as compared with the LGCM, the ALT and parallel LGCM were tested and demonstrated satisfactory goodness of fit. Based on the findings of this study, it is proposed that in addition to the traditional statistical methods of analysis (ie, logistic regression), the ALT and the parallel LGC model should be considered as alternatives for analyzing associations between two health conditions for longitudinal data. This is especially the case because this study identified a causal relationship between disability and depressive symptoms over time, which is consistent with the evidence that older adults who suffer from severe disabilities are more likely to develop depressive symptoms, which become worse as the disabilities persist (36,37). It would be appropriate to suggest, therefore, that delaying the onset of disability would be highly beneficial to the older adult, not only because it would help stop the incremental progress of the disability but also because it would also reduce the risk of them developing depressive symptoms.

This study contributes to the evidence because it is a fact that both depressive symptoms and disability are important public health issues, which substantially affect on the rising health care costs, especially for vulnerable older adults. The evidence suggests that people with disabilities tend to use more health care resources and require more informal care (38,39), which is why interventions that help to prevent and/or delay the onset of disabilities are very important, as are interventions to prevent and/or delay the onset of depressive symptoms. This study highlights that once older adults develop disabilities and depressive symptoms they will continue to become worse in both of these heath conditions. It is important, therefore, for policy makers, clinicians, and carers of older adults to be made aware of the need to seek early intervention to help prevent and/or avoid the rapid health decline of this vulnerable population.

In addition to the important afore mentioned study findings, the limitations of this study should also be acknowledged. First, the health information collected during each interview wave was reliant on the self-reporting by the older adult participants, even though this is an accepted practice according to the evidence (40). It is possible therefore that these participants may have inconsistently reported depressive symptoms and disabilities during consecutive interviews, especially because no clinical validation of these health conditions was collected. Notably, however, in an attempt to minimize recall bias, validated and reliable depressive symptom measures (Short Psychiatric Evaluation Schedule) and disability measures (PADL and IADL) were used and previously tested in the CMFAQ cohort (26). Second, the study sample was recruited from community-living Taiwanese older adults, who may not necessarily be representative of older institutionalized adults (eg, hospital inpatients or aged care facility residents). Third, depressed older adults may think differently to nondepressed older adults. In other words, negative thinking and judgment styles may function as a negative bias, resulting in an increased risk that such participants may further develop depressive symptoms in response to stressful situations during their health decline.

Overall, this study found that the initial existence of depressive symptoms among older Chinese adults from Taiwan strongly affected the further development of depressive symptoms over time. Similarly, the initial existence of disability also resulted in the progression of further disability over time. This study also found the potentiating effect of disability on initiating depressive symptoms as well as the potentiating effect of depression on initiating disability symptoms. This study confirmed that disability was predictive of the onset of depressive symptoms in most of data collection waves. Given the association between these two adverse health conditions, it is important to help delay their onset in order to reduce health care costs and to minimize care-giver burden. More research is required in this to help inform health care policy makers to improve care for this fragile population.

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